

Hot Iron

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Contents

- Logic Families
- TR Control circuit
- More tips from G3DII
- LC Measuring bridge
- Windom antenna on 6m
- Wide Range AGC
- Digital Signal Porcessing

Editorial - The role of Morse?

There has been much written in recent months about the need for a Morse Test as one of the conditions for obtaining an amateur radio licence but it seems to me that it really has little to do with radio technology as we enter the next century. It has been evident for a couple of decades that, *for commercial purposes*, the use of morse as a method of communication would soon decline to the point of extinction. The improvements in all aspects of technology have driven down the cost of using alternative methods to the point where the advantages of (usually) simple equipment are no longer important. Of course, for those of us wishing to build our own equipment, this advantage is very important. What has this to do with entry conditions for the hobby? We enjoy the privileges of being able to use a mass of different frequencies and modes because we are willing to demonstrate commitment by undertaking courses and self training. Viewed from Government's position, there is little reason to allow unrestricted access without some form of payoff because there are many other organisations who are prepared to pay considerable sums to do what we are allowed to do. The real question is what is the best

form of demonstrating that commitment. I doubt that being able to do X words per minute is really relevant - historically interesting, yes, but not suitable. We don't want something that is perceived to be a hurdle but something that demonstrates a willingness to 'stick with it'. Certainly, encouraging new entrants to start with the V/UHF bands will do nothing to improve knowledge of how a rig works and absolutely nothing to encourage home construction and experimentation with the electronics. Morse, thankfully, will definitely remain one of the many excellent alternative aspects of the hobby which is eminently suitable for those wanting to experiment. Change is needed! What do you think?

Kit Developments

Early reports on the **Langport** (SSB and CW on 20 and 80m) are very encouraging; to quote Jim Geary GW8HKY ".....Lexington North Carolina at S9 +20 and many other similarly on 20 & 80m - nocks spots off my 101E - it is the best kit yet!". Reports on the latest QRP **Booster** are also very encouraging - thank you to those who have let me know how you have got on. Over the last couple of months I have been looking for a way to get on **6m** with a few watts of RF - the solution came last week. The rest of the household are now tired of me crowing about obtaining 5 Watts from an IRF510 on 13.8 volts at 50 MHz! When I started using IRF510s more than a decade ago, I would never have guessed at the potential of these low cost devices. Transverting from 20m is my solution because it is easy to obtain the necessary 36 MHz LO for the mixer. Many home constructors will have 20m TCVRs available whereas 10m rigs are less common. I am just completing the text etc. for this kit which I have called the **Porlock** to reflect the uphill struggle to higher frequencies! It is all on a 80 x 100 mm PCB and will cost £44. Any volunteers for early builders? There is also a 10m version.

New Competition!

I have been reviewing my product line of late and would welcome your suggestions for new projects hence the draw quiz detailed on the last page. Don't miss out on your chance to win a £25 voucher!

Happy Christmas and have a good building year in 1999! Tim Walford G3PCJ

Logic Families

Digital devices are the backbone of all modern consumer electronic products including radios; despite operating in an analogue real world environment. I can confidently say all recent black box radios will at least have a digitally controlled frequency synthesiser within them and very probably at least one microprocessor. The numerical readouts are always digitally driven and over the last 35+ years several families of digital logic devices have been developed, starting with DTL (diode transistor logic) and the once common TTL (transistor transistor logic). More recently CMOS (complementary metal oxide semiconductor) devices have dominated because of their much lower power consumption and circuit simplicity leading to low cost. With most individual CMOS devices, speed increases (or propagation delays reduce) as the supply voltage is increased - there is a rough guide that for ordinary 4000 series devices the maximum speed in MHz is roughly equal to the supply voltage. Modern TTL and ECL (emitter coupled logic) are still used for very high speed tasks. There are literally hundreds of devices made by many firms in many physical formats so one should be a bit cautious about using an apparently similar device to that specified - one different letter in the part number can make a big difference. The smallest device might be just one gate - so called pico-logic; the largest might contain a whole microcomputer. As higher speed has been demanded, new ranges with lower operating voltages (which usually defines the logic voltage swing) have been designed because it is quicker to charge/discharge the circuit capacitors if the signal swing is small. If noise immunity is important because there are strong interfering signals around (e.g. transmitters), you have to use the higher voltage devices because their ability to withstand interference is often about 30 to 45% of supply voltage. The following is a very brief resume of the main families and characteristics.

4000 Series CMOS Very wide range of parts, 3 to 18 volt supply, low power, slow, 20 nS delays.

HCMOS High speed, 2 to 6 volt, low power widely used, T version for compatibility with TTL.

AHCMOS Advanced, faster than HC, 4 nS delays, 3.3 volt, few mA drive capability.

LVC MOS Low voltage, 1.2 to 3.6 volt, low speed, 4 nS delays and -24/+24 mA drive capability.

ALVCMOS Advanced LV, 2 nS delays, -24/+24 mA drive, fastest CMOS currently.

TTL - Bipolar technology, origin of 54/74 series numbers, slow and power hungry, 5 volt.

LSTTL Low power Schotky TTL, faster and less power, 5 volt, similar performance to HCMOS.

ALSTTL Advanced LS series, 4 nS delays, half the power of LS, 5 volt.

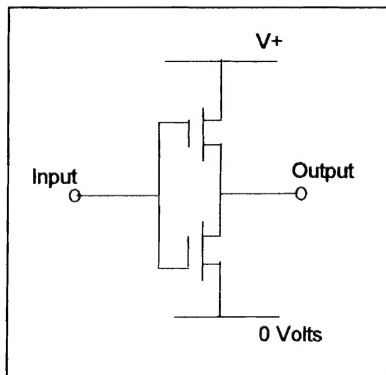
LVT Low voltage TTL, 2.7 - 3.6 volt, very high speed 2 nS delays and high drive, -32/+64 mA.

ALVT Advanced LVT, ultra fast bipolar technology, 1.5 nS delays and -32/+64 mA drive.

CBT Crossbar switch family. Near zero delays! Is more like an electronically controlled relay.

FBL Future Bus Logic, 3.3 volt version of standard 5 volt, uses BiCMOS technology, 100 mA drive.

I would suggest that for most purposes, you nowadays consider using only CMOS devices selected from the wide range of 4000 or HC series. They have low power and the HC family can be used to 50+ MHz; they are cheap and available with pins (or in surface mount!) with many sortsof gates, inverters, counters and flip-flops. In some rigs like the Sparkford, CMOS devices are used as linear amplifiers but only a few types can be used this way since the more advanced devices have many stages internally and thus tend to oscillate when feedback is applied. You should be aware of the potential for damage to any MOS device from high electrostatic voltages on their very high impedance input terminals ($10^{10}R$); if you live in a modern dry house you will need to be more careful than me in an old damp farmhouse! Get used to having all your equipment earthed and consider using a wrist strap connected through a 1M resistor to earth. Most devices are based on the simple inverter sketched in the box below.

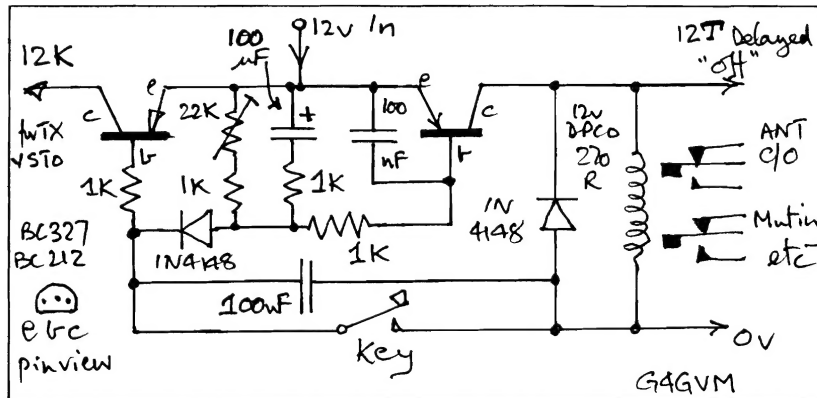


Inverting gates consist of a pair of complementary MOS transistors connected between 0 volts and the supply. Only one of them is normally on so that the transistor's main task is to charge/discharge the capacitance of the next stage during output voltage transitions. As the input changes from 0 volts to the high level (= V+), and vice-versa, both devices are temporally on so there is a small spike of current through both transistors. 4000 series devices can drive a 10K load to either 0 volts or V+; HC devices can drive a 1K load to either rail. Both series have the very high input impedance allowing slightly clever arrangements at the input for such things as timing circuits etc. A simple gate such as one of the six inverter devices in the CD4069 can be biased for linear operation with a 100K resistor from output to input. Voltage gain is about 10 to 20. G3PCJ

CW TR control circuit - by Derek Alexander G4GVM

Here is another circuit that has become a 'standard' for me. It gives positive keying of the TX while keeping the actual key at negative potential, and provides adjustable delayed return to reception.

It uses a minimum of components and fits into a very small space on a PCB. BC212s will serve for most low power needs but use BC327s if you need more output current - up to 800 mAmp.



More simple tips from Joseph Bell G3DII

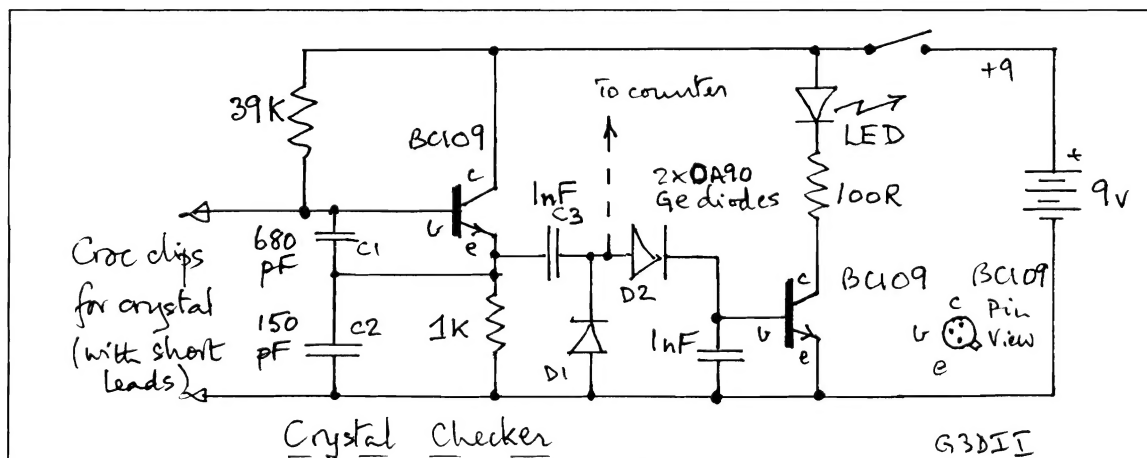
Aluminium foil (1) Ordinary kitchen ali foil can be used effectively to seal up cracks or holes which must be covered in the interests of good shielding. Cut a piece of foil large enough to cover the aperture plus an overlap then seal the overlap with masking tape preferably using the sort with a fabric base. If the aperture is small, cover the whole area with masking tape.

(2) Soldering irons. With many soldering irons, particularly of the cheaper variety, after some use, the base of the tip ceases to fit snugly in its socket. A layer of oxide forms on the base of the tip inside the socket and heat conduction is greatly impaired. Scrape the base of the tip until bright copper shows and then scrape the inside of the socket to remove the oxide scale. Then wrap the base of the tip with ali foil using enough to shim the base of the tip to a snug fit within the socket. This little tip will usually restore the iron to its original efficiency.

Drilling aluminium When drilling ali, apply a drop or two of alcohol (meths will do). This not only makes the work easier but results in a much cleaner cut.

Checking crystals for overtone activity To check a crystal for overtone activity merely wind a few turns tightly over the grid dip meter coil and connect to the crystal pins. If the crystal has overtone possibilities, the GDO will dip as the oscillator is tuned through the odd harmonic frequencies of the crystal's fundamental. Some crystals exhibit surprising results!

Checking junk crystals At rallies etc., at one time or another, most of us tend to pick up a crystal in case it might be useful at some time. The little circuit below can be built into a very small case and tell you there and then whether the crystal is active - if the less LED does not light up it is duff. The circuit will work with most crystals from 100 KHz upwards although some of the old crystals might struggle a bit if they are low frequency. A small plastic box makes a good housing for the checker. If used at home, a small capacitor connected to the side of C3 adjacent to D1 and D2 will drive your counter, the more sensitive the counter, the less the capacity needed. A minor problem when using the counter is that it may read low because of the crystal is loaded by C1 and C2. For instance, the readout might be 1 KHz low on 7 MHz and up to 3 KHz at 20 MHz.



A Basic LC Bridge - by David Proctor G0UTF

The bridge has ranges for 10 μH to 1 Henry, and 100 pF to 1 μF ; using the scaled balance control, you can resolve 2 μH - 5H and 20 pF to 5 μF . It consists of a 20 KHz oscillator feeding a bridge via a balancing transformer. The bridge balance is effected by a 1K calibrated linear pot and the balance is verified by a simple millivoltmeter.

The accuracy of the instrument is governed only by:-

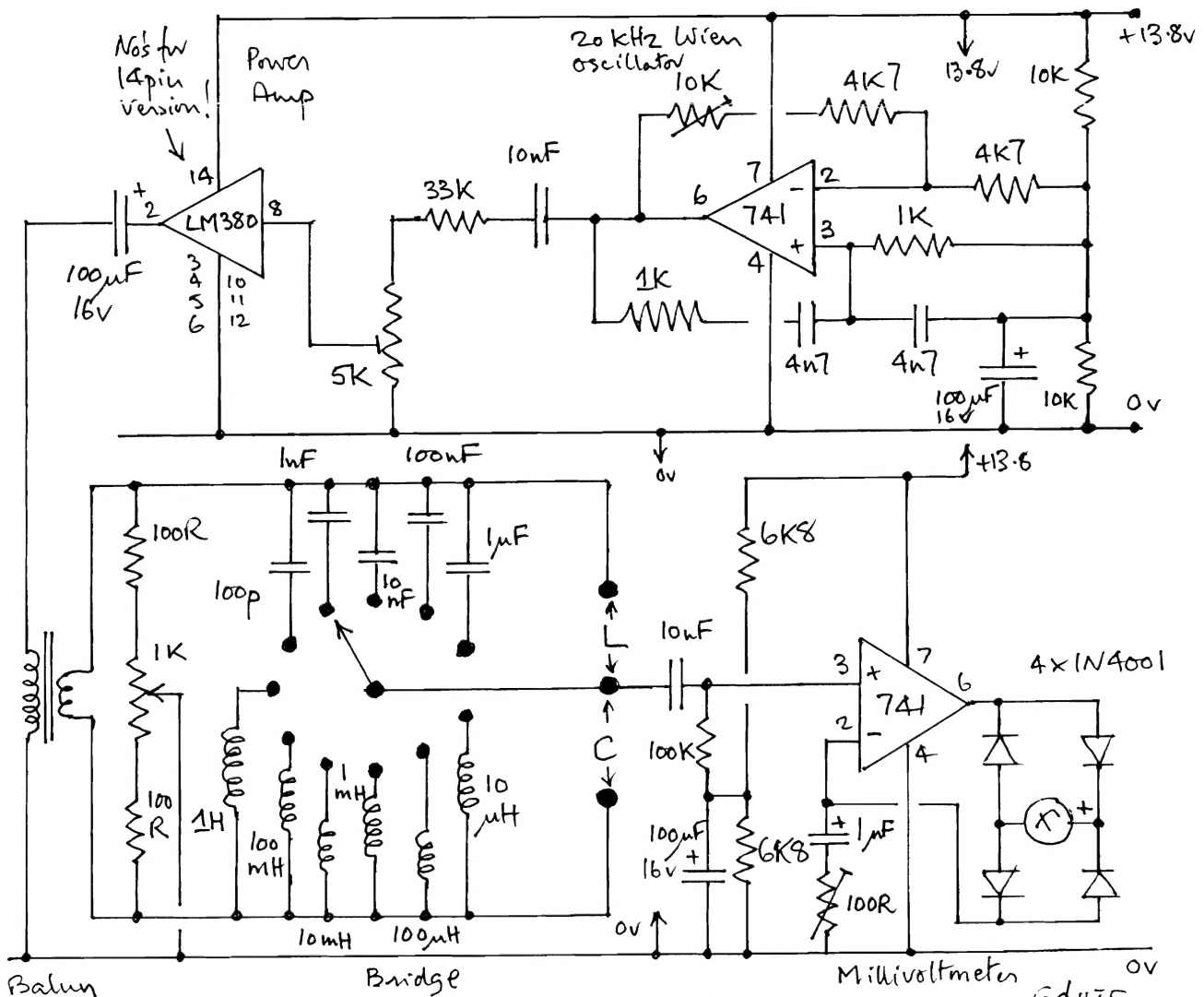
1. The linearity of the pot
2. The calibration of the pot
3. The onboard inductors and capacitors for the bridge.

Because the bridge circuit uses the null method of measurement, the accuracy of the oscillator frequency is not important, neither is the meter sensitivity. For the transformer, I went to the junk box and found an 18:1 step down (ex Coker!) (I have some still if wanted - G3PCJ.) You could even make a small step down transformer yourself with a 3:1 turns ration - at 20 KHz you don't need much core. Calibration of the 1K pot is as follows:-

Dial reading	Percentage rotation	Dial reading	Percentage rotation
0.2	10%	1	50%
0.3	18%	2	70%
0.4	24%	3	80%
0.5	30%	4	86%
0.7	39%	5	90%

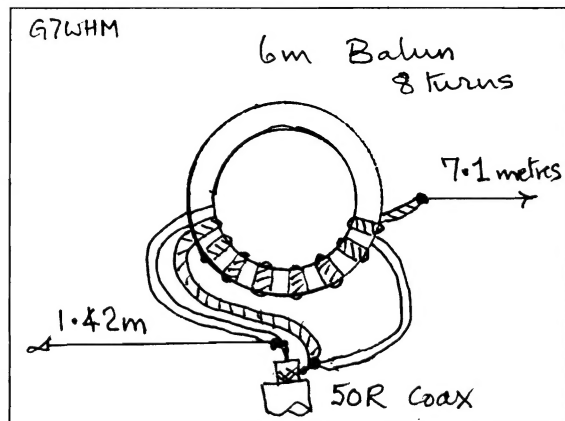
Setting up is simple:-

- Adjust the 10K feedback pot of the sinusoidal Wien bridge oscillator so that it starts/runs reliably with clipping.
- Set the 5K pot for about 3 volts RMS output from the LM380.
- Tweak the 100R for sensitivity as necessary for the meter - about 0. mAmp FSD.



Windom Antenna on 6m etc.

Andy Howgate G7WHM based his experiments on the FD4 design published in the G-QRP Club Antenna Handbook. Instead of using a section of ferrite rod, he salvaged a toroid from the filter of an old switched mode PSU. The ferrite material, although not intended for use at 50 MHz, might help and it certainly does provide a convenient former for the 8 turn windings of the matching transformer. The electrical arrangement is shown below without any supporting mechanics which are needed to prevent the wires pulling the turns out of shape. The wire was hard drawn plastic coated.



As shown it gave a maximum VSWR of 1.5:1 across the band. He also tried the same antenna on 144 MHz with considerable success; the balun showed no signs of distress after passing 25 Watts for 15 minutes. 50 Watts from his TS60 happily accessed the Norwich repeater 50 miles away - normally he has to use a collinear to achieve this.

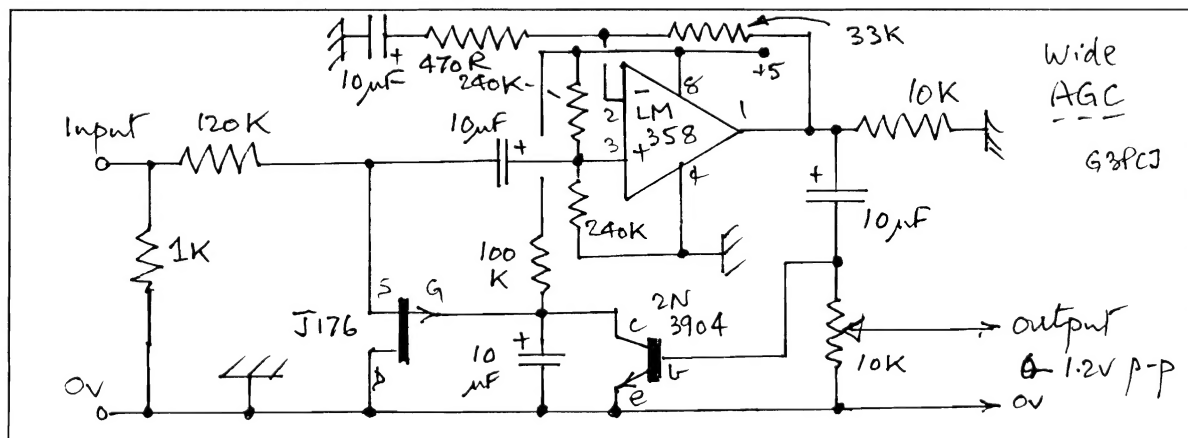
By way of comment, he changed the standard carbon pots in his Street for wire wound multi-turn types and *feels* this is a mod worth considering. He says sound quality is now almost like FM when adjusting the Fine control!

Modern carbon pots

Jim Gearey GW8HKY notes that modern pots have crimped tags instead of the older design which used rivets to hold the solder tags in place. If the tags are bent inadvertently, in the post etc. or to make the wiring arrangement neater, it tends to loosen the crimping so that in use there are intermittent connections resulting in erratic tuning. The solution is to re-tighten the 'crimps' with a pair of snipe nosed pliers before fitting to the control panel. In time the lubrication of these pots does dry up which can also make tuning irregular, again the cure is easy - a squirt of switch cleaning fluid through the holes in the protective cover followed by vigorous end to end rotation!

Wide ranging Audio AGC

I found this circuit in an American Journal; it might be useful to replace the Plessey SL6270 circuit when that becomes unobtainable. A 50 dB dynamic range is claimed, with an output level of 0 to 1.2 volts p-p (300 to 30 KHz) while operating from a 5 volt supply and drawing less than 1 mA supply current. Signal input range is 40 mV to 20 volts p-p. It works by altering the attenuation offered by the 120K input resistor working in conjunction with the variable 'resistance' of the p channel JFET under the control of the positive output peaks as DC detected by the 2N3904. The op-amp is set to run with a gain of about 67. With no, or a very low signal, insufficient to operate the detector, the FET is turned off completely by the 100K resistor to the positive supply. Higher output voltages are detected by the 2N3904 which begins to turn on drawing the gate of the FET towards 0 volts which also turns on the FET and increase the attenuation at the circuit's input. This is a negative feedback control loop. It will probably work with most modern op-amps having the ability to drive 1K or so and can use a 12 volt supply if the FET is changed to a type with a higher pinch-off voltage such as a 2N3993. The 2N3819 is not suitable - its the wrong sort being n channel! (I spent some ^{time} wondering how the FET was controlled without noticing the 'polarity'!) G3PCJ



Digital Signal Processing

Tony Measures has asked whether this might be the subject of a starter kit. The advantage of handling a signal in digital format, where a sequence of binary words (groups of binary digits) is used to represent instantaneous signal amplitude at frequent sampling intervals, is that filtering can be easily applied in mathematical processes executed by the software within the signal processing chip or microprocessor. By altering the software control parameters, it is easy to change say the cut off frequency of a low pass filter used to reject unwanted audio signals. With slight extra complication you can change the software filter from say a low pass to band pass form or include a band reject filter to get rid of an unwanted heterodyne. For a full understanding of the possibilities you need advanced mathematics with all sorts of obscure names! It is definitely not something that most of us could have a dabble with! The hardware is also quite complex, requiring an analogue to digital converter sampling at several times the highest input frequency, memory for the data samples, processor with control software in its own memory, timers and an output digital to analogue converter. All this lot can be fitted on one chip but there are very few opportunities to experiment because you have no means of control without a keyboard. Designs are already available for a complete HF receiver using digital signal processing, including all the mixing and filtering. The phasing form of single sideband receiver is easier to implement than the filter type. Watch how the technology develops! G3PCJ.

Audio loops

Quite often I see rather unsatisfactory audio wiring on rigs returned for tweaking up or repair. The most common fault is 'shared' earth returns for the LS socket and the audio gain control. This is a recipe for trouble since the relatively high currents flowing in the loud speaker are sufficiently large to cause a small audio voltage to be developed across the wire (often thin) linking the socket's 0 volts/earth contact to the main 0 volt ground plane. If the same wire is also used for earthing the audio gain control, by connecting the earthy end of the pot to the LS socket earth tag, then these small audio signals (caused by the loud speaker currents) are injected into the input of the audio amplifier and hence form a feedback loop. At some frequency within the audio band, this is quite likely to be positive so that instability is likely. Howling does not always occur, but a tendency for the audio to be rather harsh or grating at high gain control settings, is a warning sign of near oscillation. The symptoms will only be present when a low impedance LS is connected. The cure is simple. If the front panel is PCB material, make certain that it is soldered to the main PCB every inch or so and bend the tags of the socket and the pot backwards so they can be soldered direct to the back of the front panel. Alternatively use separate leads for gain control and LS socket and connect them to the ground plane a few inches apart. Use thickish wire for the LS leads. G3PCJ

Fifteenth QRP Convention

Make a note! It will take place on April 18th 1999 at Sherborne as last year. There will be the usual attractions of pre-event fun run CW competition, talks, trade stands, demonstrations, food, and a **CONSTRUCTION CHALLENGE**. The task is make a stable free running VFO settable within the range 5 to 5.5 MHz. No more than 15 parts; the winner is the one with least drift (after a 30 second warm up period) from a frequency specified on the day somewhere in the range. Full details from Peter Burridge G3CQR.

Win a £25 voucher - help me to design the kit you want!

The authors of all reasonable responses (post or e mail - see below) to the five questions below will be put into a hat just prior to the issue of the next Hot Iron. The draw will be made by a visitor. The voucher can be used against any future purchase of Somerset Range kits.

1. Describe the rig you would most like to build indicating what you think would be a realistic price.
2. What is the most complex piece of equipment that you have built previously?
3. What other topics or material should be included in Hot Iron?
4. What is the best aspect (any sort) of your preferred Somerset Range rig?
5. What is the least attractive aspect of Somerset Range kits, its importance, & suggestions for curing?

Hot Iron is a quarterly newsletter for radio amateurs interested in building equipment. It is published by Tim Walford G3PCJ for members of the **Construction Club**. Articles on simple theory, construction, testing, updates on kits, questions and suggested topics are always wanted. Please send correspondence and membership inquiries to Upton Bridge Farm, Long Sutton, Langport, Somerset, TA10 9NJ. Tel 01458 241224 E mail walfor@globalnet.co.uk The Copyright of all material published in Hot Iron is retained by TRN Walford. ©. Subscriptions are £6 per year for the UK (£8 overseas) from Sept 1st in each year.